2.2 Airports Technology

Mission

The U.S. airport system consists of 6 billion square feet of pavement with a replacement value estimated at $100 billion. There are over 600 million passenger enplanements each year at over 17,000 landing facilities with terminal buildings and access roads. Current trends indicate that the aircraft fleet will not only increase in number, but also more importantly, in operating speed, gear loading and configuration, and aircraft size; traffic demands by the year 2010 will have doubled; and airport pavements will need capital improvements costing billions of dollars.

The Airport Technology program's mission is to provide technology solutions that will allow the Nation's airports to accommodate the projected traffic growth and establish an operational environment that is free of accidents or fatalities. This is accomplished by fulfilling the FAA's regulatory obligation (49 U.S.C. 47105(b) 3) to develop standards, criteria, and guidelines for planning, designing, constructing, operating, and maintaining the massive airport system. This includes:

- Airport pavement design
- Airfield design
- Wildlife hazard mitigation
- Visual guidance systems
- Surface traction
- Post-crash rescue and firefighting, and wildlife control.

Intended Outcomes

The most important program outcomes are reducing or eliminating aircraft accidents and lowering the cost of developing and maintaining safe airports.

The Airport Technology program area supports several FAA Strategic Plan goals:

- System Safety: reduce the number of accidents in which airport surface condition is a cause or factor and reduce hazards from wildlife strikes
- System Capacity: enhance airport capacity
- Industry Vitality: enhance the vitality and international competitiveness of the U.S. commercial air transportation industry
- Global Leadership: in cooperation with industry and other Federal agencies, promote U.S. aviation system technologies
- Environmental Responsibility: create an environmentally effective and responsive FAA both domestically and internationally.

System safety. Reduction or elimination of aircraft accidents is supported by a comprehensive R&D program. The program seeks to reduce the risk of aircraft sliding off runways due to the presence of water, snow, and ice, and in the presence of other surface contaminants such as rubber and anti-icing materials. Improved runway traction is the central focus of this research, which will provide improved methods, materials, and procedures for detecting and removing contaminants from runway surfaces.

The effectiveness of soft-material arrester beds has already been proven in stopping an overrunning aircraft and the program is developing national standards for design, but more economical materials and installation methods must be found to encourage more of these installations. Ongoing research seeks methods of reducing hazards from wildlife strikes. This includes cooperative research with the Department of Agriculture in assessing wildlife hazards at airports and maintaining a national birdstrike database.

Industry Vitality, Global Leadership, and System Capacity. These are supported by a comprehensive research and development (R&D) program for airport pavement design with U.S. and international government and industry support and collaboration. The International Civil Aviation Organization (ICAO) has formally agreed to use the results from the Airport Technology program to develop worldwide pavement design standards.

The FAA's pavement research has the potential to provide large benefits. Approximately $2 billion is spent on constructing, rehabilitating, and maintaining airport pavements each year by Federal, State, and local governments and by airport operators; about $4 million is spent on research. Increasing the pavement life by as little as 10 percent through research would result in a 50 to 1 benefit/cost ratio. This is an attainable goal the program is working to achieve.

Continued research in a visual guidance system is necessary to enhance ground operations at night or under low-visibility conditions. Pilots and vehicle operators must receive clear and unambiguous information from lights, signs, and markings. Improvements in this area will help eliminate runway incursions and aircraft collisions on airport surfaces. State-of-the-art light sources and applications are necessary to enhance the safety and efficiency of aircraft operations. ICAO is using the results of United States, United Kingdom, and European research efforts to develop uniform international standards.

Research efforts are required to develop strategies for attacking post-crash fires on new multilevel, high-density seating, passenger aircraft being designed by manufacturers around the world. Elevated waterway and boom penetration devices are examples of ways to provide increased passenger survivability and evacuation protection. Training requirements and firefighting simulators must still be developed to fully utilize the new capabilities. ICAO is using research results to develop international firefighting standards.

Program Area Outputs

The airport advisory circular system is the principal means by which the FAA communicates with the user community—the Nation's airport planners, designers, operators, and equipment manufacturers. Advisory circulars (AC) present the standards used in the design, construction, installation, maintenance, and operation of airports and airport equipment. In all projects funded through the Airport Improvement Program (AIP), project work must meet standards set in one of these AC's. This requirement ensures, for example, that the $100 billion investment in airport pavement is protected, by requiring pavement construction to meet standards for design, performance, and durability. In addition, these circulars provide information that promotes safe and efficient operation under adverse weather conditions.

Over 100 AC's have been published on a wide range of technical subjects, including airport design configuration standards, pavement design and material, lighting and navigational aids, firefighting equipment and procedures, pavement condition weather sensors, wildlife control, terminal building design, snow/ice control, and friction-measuring equipment and procedures.

The FAA updates AC's as and when necessary. The information and data collected in our entire Airport Technology R&D program culminates in the updated AC's.

Program Area structure

Various elements of the Airport Technology program area affect the safety and operation of aircraft at or near the airport. Factors that determine the eventual safety of a flight include:

- Push-back from gate
- Taxi to takeoff runway
- Visibility conditions
- Lighting, markings, and signs to guide the aircraft to the departure runway
- Other ground traffic
- Runway surface conditions
- Presence of birds or deer
- Available overrun area beyond the end of the runway
- Pavement structural integrity

In addition, the potential of rejected takeoff and possible rescue efforts is a safety concern associated with every flight. This program area systematically addresses these issues with a single determination to establish an operational environment that is free of accidents and fatalities.

Customer/Stakeholder Involvement

Airport Technology's major projects support the overall FAA mission of fostering a safe and efficient airport system. Runway traction research directly supports the FAA Challenge 2000 recommendation to develop new technologies and standards for runway friction measurement and safety overrun arrester systems.

Several issues in the Aviation Safety Plan are supported by Airport Technology research. These include preventing runway incursions; improving takeoff and landing performance monitoring; developing environmentally acceptable alternatives for deicing and anti-icing agents; and improving ground navigation technologies, planning, standards, signage, and procedures.

Airport Technology rescue and firefighting research supports an ICAO initiative to replace environmentally harmful Halon 1211 for extinguishing engine fires and other fuel fires.

Aircraft manufacturers and the FAA urgently need new pavement design standards for operating next generation heavy aircraft. Manufacturers need them to assure compatibility of their aircraft on airport surfaces throughout the world. The FAA needs them to assure the public that Federal funds for rebuilding or strengthening runways are being judiciously spent to protect the $100 billion infrastructure investment.

These standards will be developed from data collected on the National Airport Pavement Test Machine—the first-ever of its kind—over the next 10 years starting in late 1998. Both the FAA and the Boeing Company are stakeholders in this important project. Financed through a cooperative R&D agreement between the FAA and the Boeing Company, the design and construction of the Machine has been completed and operation of the facility began in December 1998. Boeing is providing $7 million (one-third of the total cost) towards its completion. The FAA, Boeing, and ICAO will develop pavement design standards for ensuring aircraft-airport compatibility on a worldwide basis.

Accomplishments

During the past 5 years, the Airport Technology Program has provided products that have enhanced the safety of aircraft operations in the United States and around the world. Research underway, and which will continue into the future, will save the public billions of dollars and protect the environment while attempting to provide an operational environment free of accidents and fatalities.

The Airport Technology Program has provided an engineering solution to aircraft overruns by developing the soft ground arresting system. The Port Authorities of New York and New Jersey have authorized installation of up to five systems at New York airports at a cost of $4.5 million. The first installation was completed in December 1996, and the second is underway.

The Airport Technology Program has developed a concept for an advanced taxiway system to automatically guide aircraft to and from runways and ramps during low-visibility conditions by controlling taxiway lights and signs without inputs from radar devices. A field demonstration is planned in FY 1999. This system will reduce inadvertent aircraft incursions.

The program has improved pavement marking performance by adding retro-reflective glass beads and silica, which enhances their visibility, durability, and skid resistance.

The program has successfully tested an innovative technology for aircraft deicing using infrared energy. The first installation was completed at Rheinlander airport in Wisconsin. This technology offers potential cost savings over conventional methods.

The program has introduced a new pavement design standard to accommodate the new Boeing 777. The new standard allows the aircraft to operate without weight penalties on existing pavements. Without this standard, hundreds of millions of dollars would have been needed to strengthen U.S. airport pavements.

The program has developed a Driver's Enhanced Vision System to allow airport rescue and firefighting vehicles to navigate through fog, rain, sleet, and snow. This technology enables quick and effective response to crash sites. Several airports around the country have adopted this technology for their rescue vehicles.

R&D Partnerships

The Airport Technology Program is committed to working closely with airport operators and experts from all branches of the aviation industry and with existing expertise and facilities in the Department of Defense, academics, highway sectors, foreign countries, and the ICAO. The program developed several cost-effective partnerships and agreements, including:

- FAA-U.S. Army Waterways Experiment Station, Interagency Agreement
- FAA-U.S. Army Philadelphia District Office, Interagency Agreement
- FAA-U.S. Air Force, Tyndall Air Force Base, Interagency Agreement
- FAA-University of Illinois/Northwestern University, Center-of-Excellence for Airport

Pavement Research, Partnership through matching funds

- FAA-Boeing Company, Cooperative Research and Development Agreement, Partnership through $7 million influx from Boeing towards the Test Machine
- FAA-Canada (Public Works and Government Services) Project completion of the $21 million Pavement Arrangement for cooperative research in pavement technology
- FAA-National Aeronautics and Space Administration (NASA) Memorandum of Understanding for joint runway traction research

Through these partnerships, research results are published in scientific journals, presented at technical conferences, and discussed at workshops.

Long-Range View

Support for friction testing of new products to eliminate slipperiness as a cause of accidents will continue beyond 2003. Operation of FAA's national pavement test facility began in December 1998 and will continue for 10 years. The data collected from the test machine will allow smooth introduction of new heavy aircraft expected to join the fleet well into the next century. The pavement design standards based on these data will:

- Provide assurance to manufacturers about the compatibility of their aircraft with airports throughout the world
- Provide airport operators precise costs estimates to permit new aircraft operations at their facilities
- Allow airlines to plan for new equipment and routes
- Give airport designers confidence in their designs

This long-range commitment to improving airport technology gives the FAA the tools required to assure the public that Federal funds are being judiciously spent and that public investment in infrastructure is prudently managed.

A05a Airport Technology

GOALS:

Intended Outcomes: The FAA intends to improve airport system safety, efficiency, and capacity through advancements in aircraft technology and air traffic control systems. The FAA will also develop and maintain standards in all airport system areas to:

- Reduce aircraft accidents due to incursions, particularly in low-visibility conditions
- Reduce aircraft accidents due to slipperiness caused by ice and snow on runways
- Reduce environmental impacts due to chemical usage on airports during winter operations
- Reduce the massive investment required for pavements
- Improve post-crash rescue and firefighting capabilities
- Reduce the negative impact of wildlife on airport safety

Agency Outputs: The FAA is required by law to develop standards and guidance material for airport design, construction, and maintenance. The FAA uses the airport advisory circular system as its principal means of communicating with a user community consisting of U.S. airport planners, designers, operators, and equipment manufacturers. AC's cover airport geometric design, pavement design, safety areas, visual aids, access roads, rescue and firefighting, ice and snow control, and wildlife control. The FAA and its regional offices enforce standards and guiding material when administering the AIP.

The Airport Technology program provides the technical information necessary to support and update these agency outputs in a timely manner.

Customer/Stakeholder Involvement: Approximately $2 billion is spent annually to provide operationally safe and reliable airport pavements. About half of this amount is provided by the FAA as AIP grants; the remainder is provided by State and local governments and airport operators. Projects funded under the AIP grants must conform to the FAA AC's or standards.

Aircraft manufacturers need new pavement design standards for operation of next-generation heavy aircraft to ensure compatibility of their aircraft with airport surfaces throughout the world. To accomplish this, the FAA and the Boeing Company have entered into a Cooperative Research and Development Agreement to build a unique full-scale pavement test facility at the agency's William J. Hughes Technical Center. Data collected from the project will be used by the FAA, the Boeing Company, and ICAO in developing international pavement design standards.

The FAA needs these standards to assure the public that Federal funds for rebuilding or strengthening runways are being judiciously spent and also to protect the $100 billion investment in the U.S. infrastructure.

Accomplishments: During the past five years, the Airport Technology research program has provided products to enhance the safety of aircraft operations in the United States and around the world. Research results are published as FAA AC's and made available to users worldwide. Some major accomplishments are:

- Installed soft-ground arresting systems for stopping aircraft overruns at a major international airport
- Installed prototype advanced taxiway guidance system
- Developed improved pavement marking for enhancing visibility, durability, and skid resistance
- Began operations of an aircraft deicing facility using infrared energy at a midsize airport
- Developed driver's enhanced vision system for firefighting vehicles to navigate in rain, snow, and fog
- Developed an environmentally acceptable replacement for the chlorofluorocarbon (CFC) ozone depletor Halon 1211
- Developed specification for 55-foot elevated boom and aircraft cabin skin-penetration system
- Issued new pavement design standards to allow operation of Boeing B-777 without weight penalties
- Established a Center of Excellence (COE) in Airport Pavement Research at the University of Illinois and Northwestern University

- Installed a comprehensive instrumentation system in concrete pavements at Denver International Airport
- Established an airport pavement data base containing field data collected at Denver International Airport, allowing on-line access to researchers worldwide
- Published a technical report, *Intermodal Ground Access to Airports: A Planning Guide*

R&D Partnerships:

- FAA-U.S. Army Waterways Experiment Station*
- FAA-U.S. Army Philadelphia District Office*
- FAA-U.S. Air Force, Tyndall Air Force Base*
- FAA-USDA, National Wildlife Research Center, Sandusky, Ohio*
- FAA-University of Illinois/Northwestern University (COE for Airport Pavement Research)**
- FAA-Boeing Company, Cooperative Research and Development Agreement ($7 million Boeing/$21 million total for National Airport Pavement Test Machine)***
- FAA-Agencies of Canadian Government (for pavement technology and winter operations safety)***
- FAA-NASA (for joint runway traction research)*
- FAA-Port Authorities of New York and New Jersey (for design and construction of aircraft arrestor bed)*
- FAA-industry (to test and develop infrared-deicing facilities and soft-ground arrestor materials)

* Interagency agreement or Memorandum of Agreement (MOA)

** Partnership through matching funds

*** Cost Sharing.

Through these partnerships, research results are published in scientific journals, presented at technical conferences, and discussed at workshops.

MAJOR ACTIVITIES AND ANTICIPATED FY 1999 ACCOMPLISHMENTS:

Airport planning and design technology

- Continued data collection for taxiway centerline deviation study at John F. Kennedy Airport

Airport pavement technology

- Continued 3-dimensional finite element model (FEM) development: computational efficiency and model verification
- Updated pavement design program package (layered elastic design)
- Continued joint load transfer and layer interface models and field performance of stabilized base materials
- Continued data collection and analysis at Denver International Airport
- Published report, *Field Performance of Pre-Stressed Fibrous Concrete Pavements*

National Dynamic Airport Pavement Tests

- Completed construction and commenced test operations of the FAA's National Airport Pavement Test Machine

Airport safety technology.

- Published AC on aircraft arrestor beds
- Continued development means to acquire and report runway surface friction values for pilot use
- Completed installation and continued evaluation of prototype advanced taxiway guidance system
- Began designing next-generation airport circuitry/components test bed
- Initiated study on stability of heavy rescue vehicle and anti-rollover systems
- Continued development of the full-scale post-crash interior fire suppression facility to include second-level passenger seating cabin fires

KEY FY 2000 PRODUCTS AND MILESTONES:

- Begin data collection for taxiway centerline deviation study at Chicago O'Hare airport
- Complete pavement response tests

- Initiate performance (life) tests
- Analyze full-scale machine data to relate performance to designs
- Continue 3-dimensional FEM model development
- Continue data collection and analysis at Denver International Airport
- Conduct evaluation of prototype advanced taxiway guidance system.
- Issue specifications for improved airport lighting
- Publish testing standards for airport firefighting extinguishing agents
- Conduct study to develop new standards for anti-rollover and stability requirements for heavy airport rescue vehicles
- Publish specifications for aircraft infrared deicing system

FY 2000 PROGRAM REQUEST:

The Airport Technology FY 2000 research program is a collaborative effort among many government organizations, universities, and industry associations. The program funding requested provides the contract support necessary for an integrated, effective research program that delivers the standards and guidelines for maintaining and enhancing airport infrastructure.

A05a - Airport Technology Product and Activities	Program Schedule					
	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY2004
051-110 Airport Planning and Design Technology						
Continued Data Collection for Taxiway Centerline Deviation Study at JFK Airport	◆					
Continue Data Collection for Taxiway Centerline Deviation Study at Chicago O'Hare Airport		◇	◇			
051-120 Airport Pavement Technology						
Updated LEDFAA Pavement Design Program Package	◆					
Published Report on Field Performance of Pre-Stressed Fibrous Concrete Pavements	◆					
Continue 3D FEM Model Development	◆	◇	◇	◇	◇	
Continue Data Collection and Analysis at DIA	◆	◇	◇	◇	◇	
Analyze Full-Scale Machine Data to Relate Performance to Designs		◇	◇	◇	◇	◇
051-121 National Dynamic Airport Pavement Test						
Complete Construction of the National Airport Pavement Test Machine	◆					
Complete Pavement Response Tests		◇				
Initiate Performance (Life) Tests		◇	◇	◇	◇	◇
051-130 Airport Safety Technology						
Issued Specifications for Airport Signs	◆					
Published Advisory Circular on Aircraft Arrestor Beds	◆					
Designed Next Generation Airport Circuitry/Component Test Bed	◆					
Completed Installation and continued Evaluation Prototype Advanced Taxiway Guidance System	◆					
Initiated Study on Stability of Heavy Airport Rescue Vehicle	◆					
Conduct In-Service Evaluation Prototype Advanced Taxiway Guidance System at a Major Airport		◇				
Conduct Study to Develop New Standards for Heavy Airport Rescue Vehicles		◇	◇	◇		
Issued Specifications for Improved Airport Lighting		◇				
Publish Testing Standards for Airport Fire Fighting Agents		◇				
Publish Specification for Aircraft Infrared Deicing System		◇				
Develop Innovative Methods for Deicing/Anti-Ice Runways			◇			

Budget Authority ($ in Thousands)	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts	3,742	2,709	2,604	2,703	4,858
Personnel Costs	1,874	2,068	1,989	2,016	2,141
Other Costs	384	423	407	281	217
Total	**6,000**	**5,200**	**5,000**	**5,000**	**7,216**